Corrosion protection by films of intrinsically conducting polymers

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Polymer films are the most widely used coatings for corrosion protection. Repeatedly it was suggested for intrinsically conducting polymers (ICP's) to show a specific better protection because they can actively inhibit the corrosion process. Especially the aniline was investigated for this application [1]. Possible mechanisms were discussed [1]. One suggested mechanism is based on the redox potential of the aniline being positive enough for oxidation and passivation of iron. The polyaniline was reactivated by oxygen. This would demand a direct contact between the polymer film and the metal to be protected.

One problem with the ICP's is the film formation. Paints containing polymer dispersions were developed with limited contact between the polymer particles and the substrate. Direct film formation by oxidation is used as alternative but the adhesion to the substrate provided new problems.

We developed a coating process where we can prepare ultrathin and compact films of ICP´s on most metals [2]. The process is based on the treatment of the substrate surface with an adhesion promoter. An alkyle silane was used in the beginning, now we use alkyle phosphone compounds with the monomer of the ICP as head group [3]. The ICP film is formed by electrochemical oxidation in a solution of the ICP monomers. With such films the use of the polymers as classical primer layers is possible. The film formed is of compact nature, stable against corrosive environment and a good adhesion promoter for additional coatings.

Another application suggested is the use of these films as conversion layer [4]. The development of new conversion coatings is of prime importance because the present process, the chromate bath is banned, for political reasons, from the year 2003 on. Unfortunately, experiments with polyaniline and polythiophene on zinc gave only negative results [5].

Contrary, applying these films to iron or mild steel, in combination with a second coating, these films gave considerably increased corrosion protection in a sodium chloride electrolyte with cathodic polarization. The delamination, typical for polymer coatings under these conditions, was nearly absent in the test. The suggested explanations for the increased protection are not fully convincing. Some suggestion, at least for the standard metals in the literature will be discussed.

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